Direct Conversion of Plant Biomass to Ethanol by Engineered *Caldicellulosiruptor bescii*

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Ethanol is the most widely used renewable transportation biofuel in the US with the production of 13.3 billion gallons in 2012. In spite of considerable effort to produce fuels from lignocellulosic biomass, chemical pretreatment and the addition of saccharolytic enzymes prior to microbial bioconversion remain economic barriers to industrial deployment. We began with the thermophilic, anaerobic, cellulolytic bacterium *Caldicellulosiruptor bescii* that efficiently uses plant biomass without conventional pretreatment and engineered it to produce ethanol. We report the direct conversion of switchgrass, a non-food, renewable feedstock, to ethanol without conventional pretreatment of the biomass. This was accomplished by deletion of lactate dehydrogenase and heterologous expression of a *Clostridium thermocellum* bifunctional acetaldehyde/alcohol dehydrogenase. While wild type *C. bescii* lacks the ability to make ethanol, 70% of the fermentation products in the engineered strain was ethanol (12.8 mM ethanol directly from 2% (wt/v) switchgrass – a real world substrate) with decreased production of acetate by 38% compared to wild type. Direct conversion of biomass to ethanol represents a new paradigm for consolidated bioprocessing (CBP) offering the potential for carbon neutral, cost effective, sustainable fuel production.